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10/718,192	11/20/2003	Yian-Liang Kuo	TS03-336	9795

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EXAMINER	
CHU, CHRIS C	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 03/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/718,192	KUO ET AL.	
	Examiner	Art Unit	
	Chris C. Chu	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 January 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *25 - 29, 31 - 34, 36, 37, 41 - 45, 47 - 50, 52, 53 & 57 - 64* is/are pending in the application.

4a) Of the above claim(s) *57 - 62* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *25 - 29, 31 - 34, 36, 37, 41 - 45, 47 - 50, 52, 53, 63 & 64* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *1/6/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's amendment filed on January 6, 2006 has been received and entered in the case.

Claim Objections

2. Claims 27, 31, 43 and 47 are objected to because of the following informalities:

(A) In claims 27 and 43, line 1, it is improper to use the term "comprised of" instead of "selected from the group consisting of epoxy resin and a curing agent".

(B) In claims 27 and 43, line 2, it is improper to use the term "comprised of ... or" instead of "selected from the group consisting of copper, ... and nickel plated on aluminum".

(C) In claims 31 and 47, line 2, it is improper to use the term "comprised of ... and" instead of "selected from the group consisting of epoxy resin, ... and a coupling agent".

Appropriate correction is required.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 25, 26, 28, 29, 34, 36, 37 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over McLellan et al. (U. S. Pat. No. 6,737,755) in view of Khatri (U. S. Pat. No. 6,610,635).

Regarding claims 25 and 29, McLellan et al. discloses in e.g., Fig. 4F a heat spreader ball grid array package, comprising:

- a ball grid substrate (122);
- a semiconductor chip (124) affixed to the ball grid substrate;
- a molding compound (150 and the epoxy attaching material under the element 132) encasing the semiconductor chip over the ball grid substrate;
- a heat spreader (134) mounted over the ball grid substrate (122) and spaced apart from the molding compound (150) to form a gap (the space between the element 150 and the heat spreader 134); and
- attaching material (the epoxy attaching material on the element 132) within the gap at least between the heat spreader (134) and the molding compound (150),
- the heat spreader (134) has a shape of an inverted square pie tin having an elongated surrounding lip mounted over the ball grid substrate (see e.g., Fig. 4F) and the heat spreader (134) has a surface (the outside surface of the element 134 or a side surface) exposed to a surrounding ambient, not contacting the mounding compound (150) and the attaching material (the epoxy attaching material on the element 132).

While McLellan et al. teaches the use of the attaching material, McLellan et al. does not appear to provide any example of the attaching material being thermal grease with a specific

composition (i.e., silicon rubber containing zinc oxide; claim 29). Khatri teaches in column 2, lines 11 – 17 the attaching material may be composed of a silicon rubber containing heat-conducting particles (e.g., zinc oxide). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the silicon rubber with heat-conducting particles between the heat spreader and the molding compound structure of McLellan et al. as taught by Khatri to reduce messy installation with easier and less time-consuming and to reduce amount of grease with each application (column 2, lines 17 – 21).

Regarding claim 26, McLellan et al. discloses in e.g., Fig. 4F the semiconductor chip (124) being a silicon chip (column 2, line 53).

Regarding claim 28, While McLellan et al. discloses the material of the molding compound being comprised of epoxy resin and the use of a heat spreader, McLellan et al. does not appear to provide any example of the heat spreader's specific composition to be a copper. Khatri teaches in e.g., column 10, lines 29 – 52 a heat spreader (the block) material to be a copper (column 10, lines 29 – 52). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the copper as the specific material to form the heat spreader of McLellan et al. as taught by Khatri to minimize the resistance to heat flow and to achieve the best thermally conductive path (column 10, lines 33 – 34).

Regarding claim 34, Since McLellan et al. and Khatri disclose silicon semiconductor chip (124) that has 2 to 3 * 10^{-6}/°K of the coefficient of thermal expansion (see column 3, lines 1 – 2 of Kresge et al.), McLellan et al. and Khatri disclose the limitation "the semiconductor chip has a coefficient of thermal expansion of from "about" 2.5 to 3.5 * 10^{-6}/°K.

Regarding claim 36, McLellan et al., as modified, discloses in e.g., Fig. 4F the heat spreader (134) being mounted onto the ball grid substrate (122) at the elongated surrounding lip using epoxy adhesive (column 3, line 66 – column 4, line 1).

Regarding claim 37, McLellan et al., as modified, discloses in e.g., Fig. 4F the thermal grease "nearly" filling the gap (since the term "nearly" is a relative term and the element 150 is filled more than 60% of the gap, McLellan et al., as modified, fully meets this limitation).

Regarding claim 63, McLellan et al., as modified, discloses in e.g., Fig. 4F the heat spreader (134) comprising a tilted sidewall connected with the elongated surrounding lip (see e.g., Fig. 4F).

5. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over McLellan et al. and Khatri as applied to claim 25 above, and further in view of Long et al. (U. S. Pat. No. 5,175,612).

McLellan et al. and Khatri disclose the material of the molding compound being comprised of epoxy resin (column 3, line 59) and the use of a heat spreader (134). However, McLellan et al. and Khatri do not appear to provide any example of the epoxy molding compound also including a curing agent and the heat spreader's specific composition to be an aluminum (claim 27). Long et al. teaches in e.g., Fig. 2 an epoxy molding compound (28 and 60) also including a curing agent (column 4, lines 25 – 34) and a heat spreader (64) material to be an aluminum (column 6, lines 16 – 19). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the curing agent with the epoxy molding compound as the specific material to form the molding compound and the aluminum as

the specific material to form the heat spreader of McLellan et al. and Khatri as taught by Long et al. to provide a good heat dissipation (column 6, lines 16 – 19) by using the aluminum as the specific material to form the heat spreader in the structure.

6. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over McLellan et al. and Khatri as applied to claim 25 above, and furthermore in view of Juskey et al. (U. S. Pat. No. 5,132,778).

While McLellan et al. and Khatri disclose the material of the molding compound being comprised of epoxy resin, McLellan et al. and Khatri do not appear to provide the epoxy molding compound including curing agent, a catalyst and a coupling agent. Juskey et al. teaches in e.g., column 3, lines 6 – 9 an epoxy molding compound including curing agent, a catalyst and a coupling agent. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the curing agent, a catalyst and a coupling agent as the specific material to form the epoxy molding compound of McLellan et al. and Khatri as taught by Juskey et al. to increase performance of the epoxy molding compound (column 3, lines 12 – 13).

7. Claims 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over McLellan et al. and Khatri as applied to claim 25 above, and furthermore in view of Primeaux (U. S. Pat. No. 5,331,205).

Regarding claims 32 and 33, Since McLellan et al. and Khatri disclose the use of a copper heat spreader (column 10, lines 1 – 52 of Khatri) that has $17 * 10^{-6}/°K$ (see column 2,

lines 4 – 6 of Burgess) for the coefficient of thermal expansion, McLellan et al. and Khatri disclose the limitation "the heat spreader has a coefficient of thermal expansion of about 17.0". However, McLellan et al. and Khatri do not appear to provide any example of the epoxy molding compound's specific range of the coefficient of thermal expansion. Primeaux teaches in e.g., column 4, lines 59 – 64 the epoxy molding compound's specific range of the coefficient of thermal expansion including 10 to 60 * 10^{-6}/°K. Note that "about" 7.0 includes 10 * 10^{-6}/°K about the same based in the metes and bounds of "about" disclosed in the specification. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the 10 to 60 * 10^{-6}/°K as the specific range of the coefficient of thermal expansion for the epoxy molding compound in the structure of McLellan et al. and Khatri as taught by Primeaux to further protect the wire bonds and keep them rigidly fixed in place during subsequent transfer molding (column 4, lines 65 - 68).

8. Claims 41, 42, 44, 45, 50, 52, 53 and 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over McLellan et al. in view of Khatri, further in view of Lee et al. (U. S. Pat. No. 6,362,530).

Regarding claims 41 and 45, McLellan et al. discloses in e.g., Fig. 4F a heat spreader ball grid array package, comprising:

- a ball grid substrate (122);
- a semiconductor chip (124) affixed to the ball grid substrate;
- a molding compound (150) encasing the semiconductor chip over the ball grid substrate;

- attaching material (the epoxy attaching material on the element 132) over the molding compound; and
- a heat spreader (134) mounted over the ball grid substrate (122), the molding compound (150) and the attaching material (the epoxy attaching material on the element 132),
- the heat spreader (134) has a shape of an inverted square pie tin having an elongated surrounding lip mounted over the ball grid substrate (see e.g., Fig. 4F), and the heat spreader (134) has a sidewall surface (the side surface of the element 134) exposed to a surrounding ambient, not contacting the mounding compound (150) and the attaching material (the epoxy attaching material on the element 132).

While McLellan et al. teaches the use of the attaching material, McLellan et al. does not appear to provide any example of the attaching material being thermal grease with a specific composition (i.e., silicon rubber containing zinc oxide; claim 45). Khatri teaches in column 2, lines 11 – 17 the attaching material may be composed of a silicon rubber containing heat-conducting particles (e.g., zinc oxide). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to apply the silicon rubber with heat-conducting particles between the heat spreader and the molding compound structure of McLellan et al. as taught by Khatri to reduce messy installation with easier and less time-consuming and to reduce amount of grease with each application (column 2, lines 17 – 21).

Furthermore, while McLellan et al. and Khatri do not disclose a PCB substrate mounted to the heat spreader. Lee et al. teaches in e.g., Fig. 2D a PCB substrate (240) mounted to a heat spreader (224). It would have been obvious to one of ordinary skill in the art at the time the

present invention was made to further apply the PCB substrate of Lee et al. onto the heat spreader of McLellan et al. and Khatri as taught by Lee et al. to allow the heat spreader to be directly attached to a heat dissipating pad of the printed circuit board to dissipate heat away from die through the printed circuit board (column 7, lines 52 – 57).

Regarding claim 42, McLellan et al. discloses in e.g., Fig. 4F the semiconductor chip (124) being a silicon chip (column 2, line 53).

Regarding claim 44, While McLellan et al. and Lee et al. discloses the material of the molding compound being comprised of epoxy resin and the use of a heat spreader, McLellan et al. and Lee et al. do not appear to provide any example of the heat spreader's specific composition to be a copper. Khatri teaches in e.g., column 10, lines 29 – 52 a heat spreader (the block) material to be a copper (column 10, lines 29 – 52). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the copper as the specific material to form the heat spreader of McLellan et al. and Lee et al. as taught by Khatri to minimize the resistance to heat flow and to achieve the best thermally conductive path (column 10, lines 33 – 34).

Regarding claim 50, Since McLellan et al., Khatri and Lee et al. disclose silicon semiconductor chip (124) that has 2 to 3 * 10^{-6}/°K of the coefficient of thermal expansion (see column 3, lines 1 – 2 of Kresge et al.), McLellan et al., Khatri and Lee et al. disclose the limitation "the semiconductor chip has a coefficient of thermal expansion of from "about" 2.5 to 3.5 * 10^{-6}/°K.

Regarding claim 52, McLellan et al., as modified, discloses in e.g., Fig. 4F the heat spreader (134) being mounted onto the ball grid substrate (122) at the elongated surrounding lip using epoxy adhesive (column 3, line 66 – column 4, line 1).

Regarding claim 53, McLellan et al., as modified, discloses in e.g., Fig. 4F the thermal grease "nearly" filling the gap (since the term "nearly" is a relative term and the element 150 is filled more than 60% of the gap, McLellan et al., as modified, fully meets this limitation).

Regarding claim 64, McLellan et al., as modified, discloses in e.g., Fig. 4F the sidewall surface being a tilted sidewall surface connected with the elongated surrounding lip (see e.g., Fig. 4F).

9. Claim 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over McLellan et al., Khatri and Lee et al. as applied to claim 41 above, and further in view of Long et al. (U. S. Pat. No. 5,175,612).

McLellan et al., Khatri and Lee et al. disclose the material of the molding compound being comprised of epoxy resin (column 3, line 59) and the use of a heat spreader (134). However, McLellan et al., Khatri and Lee et al. do not appear to provide any example of the epoxy molding compound also including a curing agent and the heat spreader's specific composition to be an aluminum (claim 43). Long et al. teaches in e.g., Fig. 2 an epoxy molding compound (28 and 60) also including a curing agent (column 4, lines 25 – 34) and a heat spreader (64) material to be an aluminum (column 6, lines 16 – 19). It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the curing agent with the epoxy molding compound as the specific material to form the molding

compound and the aluminum as the specific material to form the heat spreader of McLellan et al., Khatri and Lee et al. as taught by Long et al. to provide a good heat dissipation (column 6, lines 16 – 19) by using the aluminum as the specific material to form the heat spreader in the structure.

10. Claim 47 is rejected under 35 U.S.C. 103(a) as being unpatentable over McLellan et al., Khatri and Lee et al. as applied to claim 41 above, and furthermore in view of Juskey et al. (U. S. Pat. No. 5,132,778).

While McLellan et al., Khatri and Lee et al. disclose the material of the molding compound being comprised of epoxy resin, McLellan et al., Khatri and Lee et al. do not appear to provide the epoxy molding compound including curing agent, a catalyst and a coupling agent. Juskey et al. teaches in e.g., column 3, lines 6 – 9 an epoxy molding compound including curing agent, a catalyst and a coupling agent. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the curing agent, a catalyst and a coupling agent as the specific material to form the epoxy molding compound of McLellan et al., Khatri and Lee et al. as taught by Juskey et al. to increase performance of the epoxy molding compound (column 3, lines 12 – 13).

11. Claims 48 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over McLellan et al., Khatri and Lee et al. as applied to claim 41 above, and furthermore in view of Primeaux (U. S. Pat. No. 5,331,205).

Regarding claims 48 and 49, Since McLellan et al., Khatri and Lee et al. disclose the use of a copper heat spreader (column 10, lines 1 – 52 of Khatri) that has 17 * 10^{-6}/°K (see column 2, lines 4 – 6 of Burgess) for the coefficient of thermal expansion, McLellan et al., Khatri and Lee et al. disclose the limitation "the heat spreader has a coefficient of thermal expansion of about 17.0". However, McLellan et al., Khatri and Lee et al. do not appear to provide any example of the epoxy molding compound's specific range of the coefficient of thermal expansion. Primeaux teaches in e.g., column 4, lines 59 – 64 the epoxy molding compound's specific range of the coefficient of thermal expansion including 10 to 60 * 10^{-6}/°K. Note that "about" 7.0 includes 10 * 10^{-6}/°K about the same based in the metes and bounds of "about" disclosed in the specification. It would have been obvious to one of ordinary skill in the art at the time the present invention was made to further apply the 10 to 60 * 10^{-6}/°K as the specific range of the coefficient of thermal expansion for the epoxy molding compound in the structure of McLellan et al., Khatri and Lee et al. as taught by Primeaux to further protect the wire bonds and keep them rigidly fixed in place during subsequent transfer molding (column 4, lines 65 - 68).

Response to Arguments

12. Applicant's arguments with respect to claims 25 and 41 have been considered but are moot in view of the new grounds of rejection.

Conclusion

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is 571-272-1724. The examiner can normally be reached on 11:30 - 8:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Chris C. Chu
Examiner
Art Unit 2815

c.c.
Monday, March 13, 2006

KENNETH PARKER
SUPERVISORY PATENT EXAMINER